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The descriptive epidemiology of DSM-IV Adult ADHD in the World Health Organization World Mental Health Surveys

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Author contributions

JF and RCK jointly conceived of the analyses and wrote the first draft of the manuscript. AZ and RCK designed the statistical analysis plan. NS directed the statistical analysis. IH carried out the analyses. All coauthors participated in interpretation of results and revisions.

Compliance with ethical standards

Conflict of interest

Dr. Kessler received support for his epidemiological studies from Sanofi Aventis, was a consultant for Johnson & Johnson Wellness and Prevention, and served on an advisory board for the Johnson & Johnson Services Inc. Lake Nona Life Project. Kessler is a co-owner of DataStat, Inc., a market research firm that carries out healthcare research. The other authors report no conflicts of interest.

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Abstract

We previously reported on the cross-national epidemiology of ADHD from the first 10 countries in the WHO World Mental Health (WMH) Surveys. The current report expands those previous findings to the 20 nationally or regionally representative WMH surveys that have now collected data on adult ADHD. The Composite International Diagnostic Interview (CIDI) was administered to 26,744 respondents in these surveys in high-, upper-middle-, and low-/lower-middle-income countries (68.5% mean response rate). Current DSM-IV/CIDI adult ADHD prevalence averaged 2.8% across surveys and was higher in high (3.6%)- and upper-middle (3.0%)- than low-/lower-middle (1.4%)-income countries. Conditional prevalence of current ADHD averaged 57.0% among childhood cases and 41.1% among childhood subthreshold cases. Adult ADHD was significantly related to being male, previously married, and low education. Adult ADHD was highly comorbid with DSM-IV/CIDI anxiety, mood, behavior, and substance disorders and significantly associated with role impairments (days out of role, impaired cognition, and social interactions) when controlling for comorbidities. Treatment seeking was low in all countries and targeted largely to comorbid conditions rather than to ADHD. These results show that adult ADHD is prevalent, seriously impairing, and highly comorbid but vastly under-recognized and undertreated across countries and cultures.

Keywords

ADHD; Attention-deficit/hyperactivity disorder; Comorbidity; Disability epidemiology; Impairment; Prevalence; Treatment

Introduction

While most epidemiological studies of the prevalence and correlates of childhood and adult attention deficit hyper-activity disorder (ADHD) have taken place in the USA, Australia and Western Europe, a recent increase in comparable studies in other parts of the world and the publication of several comprehensive reviews (Alhraiwil et al. 2015; Polanczyk et al. 2007; Polanczyk and Jensen 2008; Polanczyk et al. 2014; Thomas et al. 2015) make it clear that ADHD is coming to be recognized as an important disorder throughout the world given its early age-of-onset, strong associations with the subsequent onset and persistence of secondary disorders, persistence into adulthood, and strong effects on impaired role functioning throughout the life span. A challenge in comparing cross-national results, though, is that existing epidemiological studies vary widely in measures, classification systems, and data collection procedures. The largest and most systematic effort to address these methodological problems to date has been the World Health Organization's World Mental Health (WMH) Survey Initiative, a series of coordinated community epidemiological

surveys of the prevalence and burdens of adult mental disorders in countries throughout the world (Kessler and Ustun 2008). Adult ADHD was one of the disorders assessed in the WMH surveys, while retrospective reports were obtained from adult respondents about childhood ADHD. Previous WMH reports have presented data from the first 10 WMH surveys on the prevalence and descriptive correlates of childhood and adult ADHD (Fayyad et al. 2007), the associations of childhood ADHD with subsequent secondary comorbid disorders (Kessler et al. 2011), the predictors of ADHD persistence into adulthood (Lara et al. 2009), and the role impairments associated with adult ADHD (de Graaf et al. 2008). The current report presents an update on all these topic results based on a doubling of the number of countries that have completed WMH surveys since the publication of the earlier WMH reports.

Methods and materials

Samples

The WMH surveys are a series of cross-national community epidemiological surveys using consistent sampling designs, field procedures, and instruments to facilitate pooled cross-national analyses of prevalence and correlates of common mental disorders (Kessler and Ustun 2008). The countries in the initiative are in no way representative of all countries in the world or even within their region of the world, but nonetheless present an unprecedented opportunity to examine cross-national consistency and variation in prevalence and correlates of mental disorders. The data reported here come from the subset of 20 WMH surveys that assessed adult ADHD. The surveys included 11 in countries classified by the World Bank (World Bank 2012) as high-income countries (national surveys in Belgium, France, Germany, Italy, Netherlands, Northern Ireland, Poland, Portugal, Spain, and the USA along with a regional survey in Spain [Murcia]), 5 in countries classified as upper-middle-income countries (national surveys in Lebanon and Romania, a survey in all urbanized areas of Mexico, and regional surveys in Brazil [Sao Paulo] and Colombia [Medellin]), and 4 in countries classified as low-/lower-middle-income (national surveys in Colombia and Iraq, a survey in all urbanized areas of Peru, and a regional survey in the People's Republic of China [Shenzhen]). (Table 1) (Colombia was listed as both an upper-middle-and lower-middle-income country in two different surveys because Colombia's World Bank rating changed between the times of the two surveys.) Each survey was based on a probability sample of household residents in the target population using a multistage clustered area probability sample design. Response rates ranged from 45.9% (France) to 97.2% (Colombia) and had a weighted mean of 68.5% across surveys. A detailed description of sampling procedures is presented elsewhere (Heeringa et al. 2008).

Field procedures

Interviews were administered face-to-face in respondent homes after obtaining informed consent using procedures approved by local Institutional Review Boards. The interview schedule was developed in English and translated into other languages using a standardized WHO translation, backtranslation, and harmonization protocol (Harkness et al. 2008). Bilingual supervisors from each country were trained and supervised by the WMH Data

Collection Coordination Centre to guarantee cross-national consistency in field procedures (Pennell et al. 2008).

Interviews were in two parts. Part I, administered to all respondents, assessed core DSM-IV mental disorders (n = 90,712 respondents across all surveys). Part II assessed additional disorders and correlates. Part II was administered to 100% of Part I respondents who met lifetime criteria for any Part I disorder and a probability sub-sample of other Part I respondents. ADHD was assessed among respondents in the age range 18–44 in Part II (n = 26,744). The restriction on the age range was imposed based on a concern about the effects of recall bias among older respondents whereby respondents 45 years and older may not recall symptoms that they experienced in childhood. Part II respondents were weighted to adjust for differential within and between household probabilities of selection, selection into Part II, and deviations between the sample and population sociodemographic–geographic distributions. More details about WMH sample design and weighting procedures are presented elsewhere (Heeringa et al. 2008).

Measures

Diagnostic assessment—Lifetime and current DSM-IV disorders were assessed using the WHO Composite International Diagnostic Interview (CIDI) version 3.0 (Kessler and Üstün 2004), a fully structured lay-administered interview. Organic exclusion rules and hierarchy rules were used in making all diagnoses other than alcohol and drug use disorders, where abuse was defined with or without dependence and dependence was assessed only among respondents with a history of abuse. No informants other than the respondents were interviewed. As detailed elsewhere (Haro et al. 2006), blinded clinical reappraisal interviews with the Structured Clinical Interview for DSM-IV (SCID) (First et al. 2002) found acceptable-good concordance between DSM-IV/CIDI diagnoses and DSM-IV/SCID diagnoses in the four WMH countries where clinical reappraisal studies were administered (France, Italy, Spain, USA). Retrospective reports were used to date age-of-onset of each lifetime disorder using probing methods that have been shown experimentally to improve accuracy of recall (Knäuper et al. 1999).

The CIDI retrospective assessment of childhood ADHD was based on the Diagnostic Interview Schedule (DIS) (Robins and Helzer 1985). Respondents with symptoms of childhood ADHD were asked whether they still had problems with inattention or impulsivity–hyperactivity and, if so, were asked about impairments due to these symptoms. A probability subsample of 154 such respondents in the US sample was administered blinded clinical follow-up interviews to assess DSM-IV adult ADHD using the validated form of the Adult ADHD Clinical Diagnostic Scale (ACDS) Version 1.2 (Adler and Cohen 2004; Adler and Spencer 2004), a semi-structured clinical research diagnostic interview for adult ADHD. This clinical reappraisal survey is described in more detail elsewhere (Kessler et al. 2006).

Logistic regression analysis was used in the ACDS clinical reappraisal sample to predict DSM-IV/ACDS diagnoses of adult ADHD from CIDI symptom questions. Diagnostic classification accuracy was good, with area under the receiver operating characteristic curve (AUC) of .86. Based on this result, the method of multiple imputation (MI) (Rubin 1987)

was used to assign imputed clinical diagnoses of adult ADHD to respondents in all WMH surveys based on the coefficients in the prediction equation in the US clinical reappraisal sample. This approach implicitly assumes that the association between CIDI responses and clinical diagnoses is constant across countries. If this assumption is incorrect, the results will be biased. It would have been preferable to implement clinical reappraisal studies in other countries, but this was not possible.

The statistical details of the MI method are discussed elsewhere (Kessler et al. 2006). The important points to emphasize here are that MI generates unbiased prevalence estimates under the model, that individual-level estimates have good accuracy when, as in this case, AUC is high, and that a simulation that is part of the MI approach adjusts estimates of standard errors for the effects of classification error due to imperfect imputation. The imputation equation used here was somewhat less refined than in the earlier US study because not all countries included all predictors used in the US imputation equation.

Role impairments—The role impairments associated with adult ADHD were assessed using a 19-item modified version of the WHO Disability Assessment Schedule 2.0 (WHODAS; Üstün et al. 2010), a validated self-report instrument that assesses difficulties in four domains of role functioning over the past 30 days before interview: cognition (communicating and understanding); mobility (moving and getting around); self-care (personal hygiene, dressing, eating, living alone); and social interaction. The assessment includes a series of parallel questions about frequency and severity of impairment (rated *none*, *mild*, *moderate*, and *severe*) in each role domain. We focus on dichotomous classifications for whether respondents had clinically meaningful impairments in each of these four domains. In addition, the WMH surveys included a question about the number of days out of the past 30 when respondents were totally unable to carry out their normal activities due to problems with their physical or mental health. We dichotomized this variable to consider respondents who reported any versus no days out of role.

Treatment for emotional problems—All Part II respondents were asked whether they received treatment for “problems with your emotions or nerves or your use of alcohol or drugs” in the 12 months before interview from each of four different treatment sectors: mental health specialty (psychiatrist, psychologist, social worker or counselor in a mental health specialty setting, use of a mental health hotline); general medical (primary care doctor, other general medical doctor, nurse, any other health professional); human services (religious or spiritual advisor, social worker or counselor in any setting other than a specialty mental health setting); and complementary-alternative medicine (CAM; any other type of healer such as a chiropractor or native healer or participation in an internet support group or self-help group).

Analysis methods

Prevalence of ADHD and associations of ADHD with sociodemographics, comorbid DSM-IV/CIDI disorders, treatment, and role impairment were estimated using MI cross-tabulations. Sociodemographic correlates of ADHD onset and persistence into adulthood were estimated in pooled (across surveys) MI logistic regression analyses. It is noteworthy

that most of the correlates considered (educational level, employment status, marital status, income) were assessed *as of the time of interview*, which means that these variables cannot be thought of as temporally prior predictors of the onset or persistence of ADHD, but only as descriptive correlates. We also used pooled MI logistic regression analyses to estimate comorbidities and associations of ADHD with role impairment. In each of these models, we included dummy control variables for surveys, estimating each model separately in the ten MI replications and pooling results to get averaged estimates of logistic regression coefficients and design-adjusted estimates of standard errors. These coefficients and standard errors were exponentiated for ease of interpretation and are reported as odds ratios (ORs) with their 95% confidence intervals (95% CIs). The design-based Taylor series method (Wolter 1985) implemented in the SAS software system (SAS Institute Inc. 2008) was used to adjust for the weighting and clustering of observations. Design-based MI Wald Chi-square tests were used to evaluate the significance of predictor sets.

Given the strong temporal priority found between ADHD and comorbid DSM-IV/CIDI disorders, we also examined the extent to which ADHD predicted the subsequent first onset of the other disorders using the retrospective reports in the WMH surveys about age-of-onset and recency of each disorder. We made two distinctions in these analyses: between respondents who had an AD-only childhood symptom profile (i.e., the respondent had 6–9 of the 9 DSM-IV symptoms of inattention but fewer than 6 of the 9 symptoms of hyperactivity–impulsivity) and those who had a childhood HD symptom profile (i.e., the respondent had 6–9 of the 9 DSM-IV symptoms of hyperactivity–impulsivity with or without symptoms of inattention); and between onsets of secondary disorders associated with lifetime ADHD cases that were active versus remitted (based on retrospective reports about persistence of lifetime ADHD and age-of-onset of temporally secondary disorders). These specifications were examined using a discrete-time person-year survival analysis framework with person-year as the unit of analysis and a logistic link function (Singer and Willett 1993). ADHD was coded as time-varying dummy predictor variables distinguishing active and remitted AD-only and HD cases. These models included dummy control variables for surveys and person-years, estimating each model separately in the ten MI replications and pooling results to get averaged estimates of coefficients and design-adjusted estimates of standard errors. As in the person-level logistic regression models, these coefficients and standard errors were exponentiated and are reported as odds ratios (ORs) with their 95% CIs, again using the Taylor series method (Wolter 1985) to adjust for the weighting and clustering of observations.

Results

ADHD prevalence in childhood and persistence into adulthood

Prevalence of DSM-IV/CIDI ADHD in childhood averaged 2.2% across the surveys, but had an extremely wide range (0.1–8.1%) and inter-quartile range (0.9–2.9%) (Table 2). Prevalence was significantly related to country income level, with prevalence of 3.3% in high, 2.2% in upper-middle-, and 0.6% in low-/lower-middle-income countries ($\chi^2_2=113.3$, $p < .001$). Subthreshold childhood ADHD (4–5 rather than 6+ AD and/or HD symptoms in addition to other required criteria) was even more prevalent (3.7% across countries; 4.7% in

high-, 4.0% in upper-middle-, and 2.2% in low-/lower-middle-income countries; $\chi^2_2=48.9$, $p < .001$). Conditional prevalence of current (at the time of interview) adult ADHD averaged 57.0% across surveys among respondents with a history of childhood ADHD (56.2% in high-, 54.1% in upper-middle-, and 71.7% in low-/lower-middle-income countries; $\chi^2_2=2.4$, $p = .30$) and 41.1% among respondents with a history of subthreshold childhood ADHD (36.9% in high-, 46.8% in upper-middle-, and 45.9% in low-/lower-middle-income countries; $\chi^2_2=3.9$, $p = .14$). Current prevalence of adult ADHD in the total sample averaged 2.8% across surveys, again with high range (0.6–7.3%) and inter-quartile range (1.8–4.1%) and higher prevalence in high-income countries (3.6%) and upper-middle-income (3.0%) than low-/lower-middle-income (1.4%) countries ($\chi^2_2=40.5$, $p < .001$). Surprisingly, these results suggest that adult ADHD is more prevalent than childhood ADHD and that this pattern is true consistently in high (3.6 vs. 3.3%)-, upper-middle (3.0 vs. 2.2%)-, and low-/lower-middle (2.8 vs. 2.2%)-income countries. We return to this observation in the discussion section of the paper.

Sociodemographic correlates

Pooled across surveys, childhood ADHD was significantly more common among men than women (OR 1.6; 95% CI 1.3–2.0) and positively associated with level of educational attainment ($\chi^2_1=21.1$, $p < .001$) due to a significantly higher prevalence among respondents who, at the time of interview, had less than a college education compared to college graduates (ORs in the range 1.5–2.4) (Table 3). In comparison, childhood ADHD was not significantly associated with respondent age at the time of interview (which, as noted above, was in the age range 18–44), current (at the time of interview) employment status, current marital status, or current income. The same basic sociodemographic patterns were found with subthreshold childhood ADHD with the exception that prevalence was inversely associated with age at interview ($\chi^2_1=12.3$, $p < .001$). Persistence of childhood ADHD into adulthood (i.e., current prevalence) among childhood cases, in comparison, was significantly associated with respondent employment status (employed vs. all others; $\chi^2_1=11.3$, $p = .001$) due to comparatively low persistence among the currently employed. None of the sociodemographics was significantly related to adult ADHD among subthreshold childhood cases

The strength of associations of the sociodemographics with unconditional prevalence of adult ADHD was, in effect, a weighted combination of the associations with childhood ADHD in the total sample and adult persistence among childhood threshold and subthreshold cases. Unconditional adult prevalence was significantly higher among men than women (OR 1.6; 95% CI 1.3–1.9) and significantly associated with young age ($\chi^2_1=12.4$, $p < .001$), less than college educational attainment ($\chi^2_1=16.1$, $p < .001$), and being unmarried ($\chi^2_1=8.4$, $p = .004$). The higher prevalence among men than women was due to the significantly elevated risk of childhood ADHD noted above. The significant inverse association of age with current adult ADHD was due to several component associations that can be seen in other columns of the table. These include a significant inverse association of age with subthreshold childhood ADHD, an insignificant trend inverse

association of age with childhood threshold ADHD, and a significant trend inverse association of age with adult persistence of ADHD among childhood cases. The significant association of current adult ADHS with being unmarried was due to a significantly elevated odds of childhood threshold ADHD with being previously married at the time of interview (OR 1.4; 95% CI 1.1–1.9) in addition to insignificant trend associations of being previously married and never married with persistence among childhood threshold and subthreshold cases.

Comorbidities of ADHD with other DSM-IV/CIDI disorders

Twelve-month adult ADHD was significantly and positively comorbid with 12-month prevalence of other DSM-IV/CIDI disorders considered in the WMH surveys (Table 4). ORs were in the range between 2.5 (major depressive disorder) and 15.0 (oppositional defiant disorder) with individual comorbid disorders, 4.4 with a summary variable of having any comorbid disorder, and increasing ORs with number of comorbid disorders (3.0 with exactly one comorbid disorder, 6.2 with exactly two, and 9.6 with three or more; $\chi^2_1=66.7$, $p < .001$). Retrospective age-of-onset reports were used to date temporal priorities between onset ages of ADHD and comorbid disorders. Given the early age-of-onset of ADHD required in DSM-IV, it is not surprising that we found ADHD to be the temporally primary disorder in the vast majority of cases of comorbidities involving mood disorders (86.0–94.0%), anxiety disorders other than specific phobia (70.5–90.2%), and substance use disorders (94.8–99.1%). Specific phobia was the only comorbid disorder that was more likely to be temporally primary than ADHD (specific phobia first in 53.1% of cases, ADHD first in 29.1%, and same year in the remaining 17.8%).

Given the strong temporal priority of ADHD over the vast majority of comorbid disorders, we examined the extent to which ADHD predicted the subsequent first onset of the other disorders assessed in the surveys. As noted above in the section on analysis methods, we distinguished between respondents who had (1) AD-only versus HD (with or without AD) childhood symptom profiles in order to see whether those profiles are differentially associated with the subsequent onset of temporally secondary disorders. Also, we distinguished between active and remitted ADHD cases in order to determine whether the ORs of secondary disorders occurring decrease significantly with the remission of ADHD. In initial models, we also evaluated the significance of the difference between active and remitted ADHD depending on whether the childhood ADHD had an AD-only or HD symptom profile. However, as this interaction was never significant ($\chi^2_1=0.0-3.4$, $p = .88-.07$), we focused on the coefficients in the additive model (Table 5). Three broad patterns of results are noteworthy. First, all but one of the ORs for secondary disorders associated with *remitted* ADHD were elevated (ORs = 1.1–2.7, with a median of 1.6 and inter-quartile range of 1.2–2.0) and nearly half were statistically significant ($\chi^2_1=4.4-37.3$, $p = .036-< .001$). Second, the odds of secondary disorders associated with *active* ADHD were consistently elevated relative to those associated with remitted ADHD (ORs = 1.2–4.6) and nearly two-thirds of these ORs were statistically significant ($\chi^2_1=4.3-15.9$, $p = .041-< .001$). Third, the ORs associated with the AD-only subtype did not differ meaningfully from those associated

with the HD subtype, with each of the two having the same median (1.6) and very similar inter-quartile ranges (1.1–2.0 for AD-only; 1.2–2.2 for HD).

Disability in 12-month ADHD

Respondent reports of 30-day disability in role functioning based on the WHO-DAS suggest that people with adult ADHD are considerably more likely to have disability in cognition (21.8%) than in self-care (4.8%), social interactions (10.8%), or mobility (15.5%) (Table 6). Controlling for sociodemographics (age, sex, education, employment status, marital status, income), respondents with current adult ADHD have significantly elevated odds of all these outcomes. Odds ratios for these outcomes are between 3.8 (95% CI 2.9–4.8) for cognition and 2.1 (95% CI 1.4–3.3) for self-care. Respondents with current ADHD are also significantly more likely than other respondents to report at least 1 day out of role in the 30 days before interview due to health problems (OR 2.6; 95% CI 2.1–3.3). These significant associations are to some extent due to comorbid disorders rather than to ADHD, as indicated by the fact that the ORs all attenuate when controls are introduced for 12-month comorbid disorders. Nonetheless, all but one of the ORs remain significantly elevated in the range 1.5–2.1 in the latter models, the exception being an insignificant association of current ADHD with disability in self-care.

Treatment of 12-month ADHD

Roughly one-fifth (21.8%) of respondents with 12-month ADHD received some treatment for mental health problems in the 12 months before interview (Table 7). This treatment rate was significantly and positively related to country income level (28.8% in high-, 15.5% in upper-middle-, and 6.8% in low-/lower-middle-income countries; $\chi^2_2=35.8$, $p < .001$). In high-income countries, the majority of these patients were treated either in the mental health specialty sector (15.9% of all cases) or the general medical sector (17.9%). The proportions treated in these two sectors were similar to each other and considerably higher than the proportions treated in either the human services (4.9%) or CAM (4.4%) sectors. In upper-middle-and low-/lower-middle-income countries, in comparison, patients were considerably more likely to be treated in the mental health specialty sector (9.8% in upper-middle- and 5.0% in low-/lower-middle-income countries) than the general medical section (4.9% in upper-middle- and 0.6% in low-/lower-middle-income countries), with much smaller proportions of cases treated in the human services or CAM sectors (0.7–3.1% in upper-middle- and 0.3–1.6% in low-/lower-middle-income countries).

Two other observations about the 12-month treatment data are noteworthy. First, the sum of the proportions of cases treated in each of the four service sectors considered in the WMH surveys is roughly 50% higher in high-income countries (43.1% [i.e., 17.9% + 15.9% + 4.9% + 4.4%]) than the proportion of cases with any treatment in one or more of those sectors (28.8%). This means that the average person with 12-month ADHD in high-income countries who received treatment for mental health problems in the past 12 months was seen in 1.5 service sectors. This average is considerably lower in upper-middle (1.2 service sectors)- and low-/lower-middle (1.1 service sectors)-income countries. Previous WMH analyses have shown that this pattern of obtaining care for emotional problems in multiple

service sectors in high-income countries is typical of people with a wide range of other DSM-IV disorders and is not unique to ADHD (Wang et al. 2007).

Second, 12-month treatment *specifically for ADHD* among respondents with 12-month ADHD (shown in the last column of the table) was dramatically lower than 12-month treatment for any emotional problems among the same respondents (3.3 vs. 21.8%). This same pattern was found in high (5.1 vs. 28.8%)-, upper-middle (1.4 vs. 15.5%)-, and low-/lower-middle (0.0 vs. 6.8%)-income countries. It is noteworthy that the respondents with 12-month ADHD in this table include both those with and without other comorbid disorders. The finding that the vast majority of treatment is for other disorders is consistent with the finding that a substantial part of the impairment of respondents with adult ADHD is associated with comorbid disorders, although it is noteworthy that odds of serious difficulties with cognition among adults with ADHD are 2.1 of those other respondents after adjusting for comorbid conditions. This observation might mean that many people do not interpret serious difficulties with cognition as mental problems requiring treatment by a mental health professional. Although the WMH surveys did not ask about this matter, answers might be valuable in helping to craft public education messages to attract adults with ADHD into treatment. Be that as it may, the result suggests that the vast majority of adults with ADHD who are in treatment also have some other comorbid mental disorders that are the focus of treatment, although our analysis made no attempt to distinguish subsamples of respondents with pure and comorbid ADHD or to determine which comorbid disorders were most likely to be the presenting complaints. A question also can be raised as to how often the treating clinicians are aware that these patients have comorbid ADHD. These are all important questions that should be the focus of attention in future studies.

Discussion

Several limitations of the WMH data are noteworthy. The most obvious one is that adult ADHD was estimated from an imputation model rather than directly. As noted above in the section on measures, this approach generates unbiased prevalence estimates with good precision *under the model* when, as in our case, AUC is high and the population to which results are extrapolated are equivalent to the population in which the imputation was calibrated. But it is important to note that calibration was carried out only in the USA, which was an outlier in terms of prevalence, raising questions about the accuracy of the diagnostic threshold in other countries. Given that we have no guarantee that the model holds in all WMH countries, caution is consequently needed in interpreting results regarding prevalence estimates. Another feature of the multiple imputation method is that estimates of associations with outcomes are attenuated due to the inclusion of imputation error even when this error is random. This means that the results reported here on the associations of adult ADHD with secondary comorbid disorders and disability are likely to be conservative; that is, that the true associations are likely to be larger than those estimated here.

It is clear from the above comments that it would be valuable to have a practical screening scale that is validated across many countries to assess adult ADHD rather than rely on imputation. The WMH collaborators have developed a screening scale of this sort based on follow-up analyses of WMH respondents in the USA (Kessler et al. 2005), and this

screening scale has been validated in a number of countries (e.g., Lozano et al. 2016; Morin et al. 2016; Sjolander et al. 2016). Based on the good performance of the scale in these independent validation studies, an updated DSM-5 version of the scale is being developed and will be used in future WMH surveys to avoid the need to continue using imputation to estimate prevalence of adult ADHD. For now, though, caution is needed in interpreting cross-national prevalence estimates for the existing WMH surveys and more work is needed to investigate possible substantive and methodological explanations for the large cross-national difference in prevalence estimates reported here. Also, it has to be understood that the associations reported here of other variables with adult ADHD are likely to be lower-bound estimates due to the attenuation introduced by the use of multiple imputation.

Another limitation of the current study is that childhood ADHD was assessed retrospectively, although concern about recall bias is limited somewhat by the fact that we restricted these retrospective questions to respondents no older than 44. But then, this restriction introduces another limitation that estimates are not available for respondents older than 44 years of age. Another limitation is that all diagnoses were based on fully structured lay diagnostic interviews rather than semi-structured clinical research diagnostic interviews. Concerns about these limitations are lessened to some degree by the fact that clinical reappraisal studies carried out in a number of WMH countries documented generally good concordance between diagnoses based on the CIDI and independent clinical diagnoses (Haro et al. 2006) based on blinded SCID clinical reappraisal interviews (First et al. 2002). However, these clinical reappraisal interviews were administered only in a minority of WMH countries, so some uncertainty still exists in the extent to which the favorable results generalize to all countries. Additionally, recall bias could lead to underreporting the number of childhood ADHD symptoms. We addressed this possibility by including and analyzing retrospective reports of subthreshold ADHD. With the change of the age-of-onset requirement from DSM-IV to DSM-5 (from 7 to 12 years), many of the respondents classified as subthreshold cases would have been threshold cases (due to ease of recall of symptoms around 12 years of age as opposed to 7 years of age).

Within the context of these limitations, the results reported here build on previous evidence about the cross-national epidemiology of ADHD in a number of ways. The most basic of these involves prevalence estimates. Population prevalence estimates for childhood ADHD have varied widely in previous epidemiological surveys, from less than 1% to over 20%, but with a central tendency of 4–6%. A recent quantitative analysis of worldwide studies reported pooled current prevalence estimates of 6.5% for children and 2.7% for adolescents (Polanczyk et al. 2007). The WMH retrospective estimate of 3.3% in high-income countries is intermediate between these two estimates, while the estimate of 2.2% in upper-middle-income countries is lower and the estimate of 0.6% in low-/lower-middle-income countries substantially lower than the lower bounds of these estimates.

Much less evidence exists on the population prevalence of adult ADHD. Early studies suggested that prevalence is low based on evidence of low adult persistence in studies that followed patients who were treated for ADHD as children into adulthood (Faraone et al. 2006; Hill and Schoener 1996), but there are a number of obvious methodological flaws with such studies (Mannuzza et al. 2003; Sawilowsky and Musial 1988). General population

screening studies subsequently carried out found much higher prevalence estimates, with a meta-analysis estimating average prevalence to be 2.5% (Simon et al. 2009) and subsequent community surveys reporting results generally consistent with this estimate: 5.8% in Brazil (Polanczyk et al. 2010), 3.0% in France (Caci et al. 2014), 4.7% in Germany (de Zwaan et al. 2012), 1.3–4.6% (threshold–subthreshold) in Hungary (Bitter et al. 2010), and 1.1% in South Korea (Park et al. 2011). The WMH prevalence estimate of 2.8% is very similar to the average estimate in the meta-analysis (which, importantly, did not include any of the WMH surveys in the review), although the WMH series includes a much wider range of countries and, as with childhood ADHD, finds a strong association between country income level and prevalence.

One striking result of our prevalence analysis is that the estimated prevalence of adult ADHD is higher than that of childhood ADHD. This is true because a substantial proportion of adult threshold cases were subthreshold childhood cases according to retrospective reports. As one might expect, transition probabilities for becoming an adult case were higher for childhood threshold than subthreshold cases, but the fact that there were so many childhood subthreshold cases and the fact that the transition probabilities to adult cases were relatively substantial for those subthreshold childhood cases combine to result in a substantial proportion of adults with ADHD reporting sub-threshold ADHD in childhood.

Previous prospective studies that focused on follow-up of childhood cases into adulthood are unable to evaluate the possibility that many adults with ADHD had sub-threshold symptoms in childhood, as the denominator population for these studies consisted of patients who had threshold ADHD in childhood. It would be valuable for prospective community-based research to investigate this issue by following epidemiological samples of children who were classified as having either threshold or sub-threshold ADHD in community surveys or school surveys (e.g., Green et al. 2010) into adulthood to determine whether or not the retrospective WMH results hold up prospectively. Another possibility is that this pattern in the WMH data might be due to downward recall bias about the severity of childhood symptoms among adults with threshold ADHD. It is noteworthy, though, that another related issue is that a higher proportion of subthreshold childhood cases will become threshold cases in adulthood when DSM-5 diagnostics are used, as DSM-5 requires only 5 symptoms of either AD or HD for a diagnosis of adult ADHD compared to 6 in DSM-IV and 6 for childhood cases in both DSM-IV and DSM-5.

By combining retrospectively recalled threshold and subthreshold childhood ADHD in the total sample (2.2 and 3.7% respectively), the current rate of 2.8% of adult ADHD reflects a persistence rate of 47.4%. Since we did not measure subthreshold adult ADHD, this persistence rate is likely to be an underestimate of the true persistence of ADHD from childhood into adulthood. Recent community cohort studies have suggested that there may be cases of “adult onset” ADHD among individuals without a prior history of ADHD in childhood (Agnew-Blais et al. 2016; Caye et al. 2016a; Moffitt et al. 2015). As the CIDI did not inquire about new onset ADHD in adulthood among respondents who did report at least subthreshold ADHD in childhood, our reported prevalence may therefore underestimate the total current prevalence of adult ADHD.

It is unclear whether the association of ADHD prevalence with country income level reflects differences in true prevalence, differential recall, differential validity of the CIDI questions across countries, or some combination of these factors. One strong possibility is that objectively assessed inattention and hyperactivity–impulsivity might be less impairing in lower-income than higher-income countries given that these symptoms might interfere less with the role demands of people in the former than latter countries. Given the very strong cross-national gradient and the plausibility of this possibility, it would be valuable to carry out a cross-national comparative analysis that used objective performance-based neurocognitive tests to evaluate prevalence of the cognitive deficits underlying adult ADHD rather than relying only on self-report assessments. It is noteworthy in this regard that performance-based neurocognitive tests have been used in a number of recent studies of adult ADHD (e.g., Dehili et al. 2013; Micoulaud-Franchi et al. 2016; Surman et al. 2015) and could be used in parallel in community surveys using recently developed technology for administering such tests in web-based surveys (www.manybrains.net). It is important to note in this regard, though, that the neurocognitive tests studied in adult ADHD up to now have been heterogeneous, in many cases only weakly correlated with each other, and non-specific for adult ADHD, making it unclear whether this line of research has yet progressed sufficiently to warrant implementing such tests in large-scale cross-national community epidemiological surveys.

Previous research has also studied sociodemographic correlates of ADHD. Perhaps the most consistently documented correlate is sex, with prevalence consistently higher among boys than girls and a higher relative prevalence of the predominantly inattentive subtype among girls than boys (Rucklidge 2010). Although earlier estimates indicated a male-to-female ratio of 9:1, a subsequent meta-analysis concluded that the true prevalence ratio is closer to 2.45:1 in non-referred community samples (Polanczyk and Jensen 2008). This finding suggests that previously reported higher ratios may have been a function of referral or treatment bias, as it is known that a higher proportion of boys than girls with ADHD receive treatment (Derks et al. 2007). The WMH OR of 1.6 for childhood ADHD among boys/girls was somewhat lower than that average. We also found the same OR for adult ADHD due to the absence of a significant sex difference in persistence of childhood ADHD into adulthood. This finding is consistent with a recent meta-analysis (which, it should be noted, included the results of an early WMH analysis of the predictors of persistence of childhood ADHD into adulthood based on our first 10 surveys [Lara et al. 2009]), which failed to find a significant gender difference in persistence of ADHD into adulthood (Caye et al. 2016b).

Age is a second sociodemographic characteristic that has been examined in studies of ADHD prevalence. Meta-analysis finds that this association is negative (Simon et al. 2009), a result that we replicate in the WMH surveys despite the fact that the age range of our sample was truncated (18–44). Other commonly studied correlates are various indicators of socioeconomic status (SES). Although the associations of childhood ADHD with these correlates are confounded in treatment samples by selection bias, we would expect an inverse association with parental SES by virtue of the high heritability of childhood ADHD (Posthuma and Polderman 2013) along with an association of ADHD with low socioeconomic attainment (Polderman et al. 2010). Meta-analysis shows, consistent with this expectation, that parental SES is inversely related to childhood ADHD, with children

from low-SES families having an ADHD prevalence close to twice that of other children (Russell et al. 2016).

The WMH data focused on respondent SES rather than parental SES. We found that while both threshold and sub-threshold childhood ADHD were associated with significant reductions in odds of completing college, persistence of childhood ADHD into adulthood was not associated with educational attainment. The significant association of childhood ADHD with reduced educational attainment is consistent with the results of a meta-analysis (Polderman et al. 2010), but we are unaware of any previous research on educational attainment and persistence of childhood ADHD into adulthood. It is conceivable that low educational attainment is influenced by childhood but not adult ADHD, while level of educational attainment among individuals who have completed their education has no influence on the course of ADHD. A more perplexing finding is that we failed to find a significant association between respondent family income per family member and adult ADHD. This result is inconsistent with other evidence suggesting that adult ADHD is associated with low family income (Martel 2013). The reason for this discrepancy between the WMH results and the results of earlier studies is unclear.

Finally, we found that respondents with adult ADHD are significantly less likely than other respondents to be currently married due to an elevated odds of being previously married. This finding is consistent with previous research showing that adult attention deficits are elevated among people who are divorced (Bouchard and Saint-Aubin 2014). Our finding of high comorbidity in ADHD is consistent with much previous research (Babcock and Ornstein 2009; Karlsdotter et al. 2016; Mao and Findling 2014), although it is unclear from these data whether ADHD is a causal risk factor or a noncausal risk marker. Our finding that respondents with remitted ADHD continue to have elevated risk of subsequent first onset of several other disorders argues indirectly for ADHD being a noncausal risk marker, but the even more consistently significant elevated odds of secondary disorders associated with active than remitted ADHD raise the possibility that ADHD might also be a causal risk factor for secondary disorders. This issue is becoming one of increasing public health importance, as interest grows in focusing on treatment of childhood ADHD as a secondary prevention strategy for downstream disorders. Research in this area is coming to recognize that a number of mediators and moderators of the presumed effects of ADHD on secondary disorders might exist that represent alternative targets for preventive intervention (Molina and Pelham 2014). Our retrospective finding that individuals with remitted ADHD have the same significantly elevated risk of some subsequent secondary disorders such as alcohol use disorder as those with active ADHD could be of value here in leading a recognition that *history* of childhood ADHD (i.e., whether or not still active) is a risk marker for subsequent onset of alcohol abuse (Tuithof et al. 2012).

Our results regarding role impairments are also consistent with much previous research in showing that adult ADHD is associated with substantial impairments in productive role functioning (Kupper et al. 2012), social role functioning (Bouchard and Saint-Aubin 2014), and most strongly in cognitive functioning (Ivanchak et al. 2012). However, we also showed that substantial proportions of these associations are more proximally due to comorbid mental disorders. Our analysis did not distinguish between mediation effects (e.g., ADHD

causes secondary comorbid disorders that, in turn, cause role impairments) or synergistic effects in which the conjunction of ADHD and comorbid disorders is associated with a level of impairment that is meaningfully different from the level expected based on an additive model. More complex analyses than those carried out here would be required to distinguish these possibilities. Furthermore, given the evidence that remitted ADHD often predicts subsequent onset of secondary disorders, a question can be raised whether some unmeasured biological and/or environmental determinants of both ADHD and later-onset disorders might account for the impairments associated with ADHD. An investigation of this possibility is beyond the scope of this report. However, we know from experimental research on the effects of ADHD treatment on objective performance data (e.g., simulated driving tests) that at least some part of the association between adult ADHD and role performance is due to a direct and modifiable causal effect of ADHD (Biederman et al. 2012), implying that if these role impairments, which are known to remit with the remission of ADHD, played a part in predicting subsequent onset of temporally secondary disorders, we would expect that risk of these disorders would return to their level in the general population with the remission of ADHD. That the WMH results suggest that this risk does not return to the population level after ADHD remission consequently implies that factors other than the impairment caused by ADHD account for the associations of remitted ADHD with subsequent onset of temporally secondary disorders.

Our results regarding 12-month adult ADHD treatment, finally, are broadly consistent with much other research in showing that only a minority of people with mental disorders obtain treatment and that this treatment rate is lower in less developed than developed countries (Wang et al. 2007). Other WMH research on treatment seeking for mental disorders has shown that the most important barrier is failure to recognize that the symptoms of the disorder constitute evidence of an “illness” that could profit from treatment (Andrade et al. 2014). Not only ADHD but also other disorders with symptoms that are, in effect, extreme versions of normal experiences that either begin in childhood (e.g., extreme shyness in social phobia) or develop slowly over time (e.g., extreme worry in generalized anxiety disorder) have this profile of low treatment seeking for the disorder (ten Have et al. 2013) and the majority of patients are in treatment for a comorbid disorder that is more readily recognized as a condition needing treatment (e.g., depression, alcohol abuse). This lack of awareness has been noted in the past and has led to calls for increased public and professional training on how to diagnose adult ADHD (Asherson et al. 2012). Our results suggest strongly that training programs of this sort are needed.

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Table 1

WMH sample characteristics by World Bank income categories

	Survey[a]	Sample characteristics[b]	Field dates	Age range	Sample size		Response rate[d]
					Part I	Part II[c]	
I. High-income countries							
Belgium	ESEMeD	Nationally representative. The sample was selected from a national register of Belgium residents	2001–2002	18–95	2419	486	50.6
France	ESEMeD	Nationally representative. The sample was selected from a national list of households with listed telephone numbers	2001–2002	18–97	2894	727	45.9
Germany	ESEMeD	Nationally representative	2002–2003	19–95	3555	621	57.8
Italy	ESEMeD	Nationally representative. The sample was selected from municipality resident registries	2001–2002	18–100	4712	853	71.3
Netherlands	ESEMeD	Nationally representative. The sample was selected from municipal postal registries	2002–2003	18–95	2372	516	56.4
Northern Ireland	NISHS	Nationally representative	2004–2007	18–97	4340	907	68.4
Poland	EZOP	Nationally representative	2010–2011	18–65	10,081	2276	50.4
Portugal	NMHS	Nationally representative	2008–2009	18–81	3849	1070	57.3
Spain	ESEMeD	Nationally representative	2001–2002	18–98	5473	960	78.6
Spain—Murcia	PEGASUS-Murcia	Murcia region	2010–2012	18–96	2621	631	67.4
USA	NCS-R	Nationally representative	2002–2003	18–99	9282	3197	70.9
Total					(51,598)	(12,244)	60.7
II. Upper-middle-income countries							
Brazil—São	São Paulo	São Paulo metropolitan area	2005–2007	18–93	5037	1824	81.3
Paulo	Megacity						
Colombia—Medellin[f]	MMHHS	Medellin metropolitan area	2011–2012	19–65	3261	970	97.2
Lebanon	LEBANON	Nationally representative	2002–2003	18–94	2857	595	70.0
Mexico	M-NCS	All urban areas of the country (approximately 75% of the total national population)	2001–2002	18–65	5782	1736	76.6
Romania	RMHS	Nationally representative	2005–2006	18–96	2357	940	70.9
Total					(19,294)	(6065)	78.7
III. Low-/lower-middle-income countries							
Colombia	NSMH	All urban areas of the country (approximately 73% of the total national population)	2003	18–65	4426	1731	87.7
Iraq	IMHS	Nationally representative	2006–2007	18–96	4332	3227	95.2

	Survey[a]	Sample characteristics[b]	Field dates	Age range	Sample size		Response rate[d]
					Part I	Part II[c]	
Peru	EMSMP	All urban areas of the country	2004–2005	18–65	3930	1287	90.2
PRC[e]—Shenzhen[g]	Shenzhen	Shenzhen metropolitan area. Included temporary residents as well as household residents	2006–2007	18–88	7132	2190	80.0
Total					(19,820)	(8435)	86.7
IV. Total					(90,712)	(26,744)	68.5

The World Bank (2012) Data. Accessed May 12, 2012 at: http://data.worldbank.org/country. Some of the WMH countries have moved into new income categories since the surveys were conducted. The income groupings above reflect the status of each country at the time of data collection. The current income category of each country is available at the preceding URL

[a]NSMH (The Colombian National Study of Mental Health); IMHS (Iraq Mental Health Survey); EMSMP (La Encuesta Mundial de Salud Mental en el Peru); MMHHS (Medellín Mental Health Household Study); LEBANON (Lebanese Evaluation of the Burden of Ailments and Needs of the Nation); M-NCS (The Mexico National Comorbidity Survey); RMHS (Romania Mental Health Survey); ESEMeD (The European Study Of The Epidemiology Of Mental Disorders); NISHS (Northern Ireland Study of Health and Stress); EZOP (Epidemiology of Mental Disorders and Access to Care Survey); NMHS (Portugal National Mental Health Survey); PEGASUS-Murcia (Psychiatric Enquiry to General Population in Southeast Spain-Murcia); NCS-R (The US National Comorbidity Survey Replication)

[b]Most WMH surveys are based on stratified multistage clustered area probability household samples in which samples of areas equivalent to counties or municipalities in the USA were selected in the first stage followed by one or more subsequent stages of geographic sampling (e.g., towns within counties, blocks within towns, households within blocks) to arrive at a sample of households, in each of which a listing of household members was created and one or two people were selected from this listing to be interviewed. No substitution was allowed when the originally sampled household resident could not be interviewed. These household samples were selected from census area data in all countries other than France (where telephone directories were used to select households) and the Netherlands (where postal registries were used to select households). Several WMH surveys (Belgium, Germany, Italy) used municipal resident registries to select respondents without listing households. 13 of the 20 surveys are based on nationally representative household samples

[c]Iraq and Romania did not have a Part II sample and the N represents their Part I sample with an age ≤ 44 restriction. All other countries were age restricted to ≤44 in the Part II sample

[d]The response rate is calculated as the ratio of the number of households in which an interview was completed to the number of households originally sampled, excluding from the denominator households known not to be eligible either because of being vacant at the time of initial contact or because the residents were unable to speak the designated languages of the survey. The weighted average response rate is 68.5%

[e]People's Republic of China

[f]Colombia moved from the "low-/lower-middle-income" to the "upper-middle-income" category between 2003 (when the Colombian National Study of Mental Health was conducted) and 2010 (when the Medellin Mental Health Household Study was conducted), hence Colombia's appearance in both income categories. For more information, please see the first note under table regarding The World Bank

[g]For the purposes of cross-national comparisons, we limit the sample to those 18+

Table 2

Multiply imputed prevalence estimates of DSM-IV/CIDI attention-deficit hyperactivity disorder in each WMH sample

	Childhood ADHD				Adult ADHD among childhood cases of…				Adult ADHD in the total sample		(*n*)[a]
	Threshold		Subthreshold		Threshold		Subthreshold				
	%	(SE)	%	(SE)	%	(SE)	%	(SE)	%	(SE)	
I. High-income countries											
Belgium	2.9	(1.1)	8.6	(2.1)	71.9	(16.5)	22.7	(10.0)	4.1	(1.5)	(486)
France	4.7	(1.2)	8.9	(1.4)	58.8	(14.0)	50.9	(10.5)	7.3	(1.8)	(727)
Germany	1.8	(0.7)	5.6	(1.5)	67.9	(16.1)	33.7	(8.5)	3.1	(0.8)	(621)
Italy	0.9	(0.2)	3.7	(0.7)	84.1	(11.1)	55.1	(11.2)	2.8	(0.6)	(853)
Netherlands	2.9	(0.9)	9.2	(1.6)	82.3	(14.4)	28.4	(9.3)	5.0	(1.6)	(516)
Northern Ireland	3.2	(0.8)	4.5	(0.7)	98.8	(2.0)	64.0	(8.2)	6.0	(0.8)	(907)
Poland	0.3	(0.1)	0.8	(0.2)	69.7	(9.4)	62.6	(14.5)	0.8	(0.2)	(2276)
Portugal	1.5	(0.4)	4.0	(0.7)	56.3	(15.3)	54.0	(11.1)	3.0	(0.7)	(1070)
Spain	1.8	(0.8)	1.9	(0.5)	33.6	(20.6)	29.2	(12.3)	1.2	(0.6)	(960)
Spain—Murcia	2.0	(0.5)	4.2	(0.7)	72.9	(21.6)	44.3	(17.5)	3.3	(1.1)	(631)
USA	8.1	(0.6)	6.6	(0.5)	46.0	(4.9)	22.5	(4.6)	5.2	(0.6)	(3197)
Total	3.3	(0.2)	4.7	(0.3)	56.2	(4.8)	36.9	(4.3)	3.6	(0.4)	(12,244)
II. Upper-middle-income countries											
Brazil—São Paulo	2.5	(0.4)	7.0	(1.0)	76.2	(14.5)	58.2	(10.7)	5.9	(1.2)	(1824)
Columbia—Medellin	2.5	(0.5)	3.0	(0.7)	59.2	(10.7)	51.5	(12.5)	3.0	(0.7)	(970)
Lebanon	1.5	(0.4)	3.3	(1.2)	52.4	(15.0)	29.9	(17.1)	1.8	(0.7)	(595)
Mexico	3.0	(0.4)	3.7	(0.7)	32.8	(7.3)	25.8	(8.6)	1.9	(0.4)	(1736)
Romania	0.4	(0.3)	0.7	(0.4)	45.7	(40.8)	54.7	(24.3)	0.6	(0.4)	(940)
Total	2.2	(0.2)	4.0	(0.4)	54.1	(7.0)	46.8	(7.6)	3.0	(0.5)	(6065)
III. Low-/lower-middle-income countries											
Columbia	1.2	(0.3)	2.9	(0.5)	84.9	(10.2)	51.5	(8.8)	2.5	(0.5)	(1731)
Iraq	0.1	(0.1)	1.0	(0.2)	77.0	(19.2)	47.9	(14.6)	0.6	(0.2)	(3227)
Peru	0.8	(0.2)	2.5	(0.5)	58.4	(14.1)	35.4	(12.4)	1.4	(0.5)	(1287)
PRC[b]—Shenzhen	0.7	(0.2)	3.0	(0.6)	62.8	(21.4)	46.1	(8.2)	1.8	(0.4)	(2190)
Total	0.6	(0.1)	2.2	(0.2)	71.7	(9.5)	45.9	(5.5)	1.4	(0.2)	(8435)

	Childhood ADHD				Adult ADHD among childhood cases of…				Adult ADHD in the total sample		(*n*)[a]
	Threshold		Subthreshold		Threshold		Subthreshold				
	%	(SE)	%	(SE)	%	(SE)	%	(SE)	%	(SE)	
IV. Total	2.2	(0.1)	3.7	(0.2)	57.0	(4.4)	41.1	(4.3)	2.8	(0.3)	(26,744)
χ^2	113.3 *		48.9 *		2.4		3.9		40.5 *		

Sample restricted to respondents ages 18–44 at interview and Part II sample

*Significant at the .05 level, two-sided test

[a]These are denominator *n*'s; that is, the number of people assessed rather than the number with ADHD

[b]People's Republic of China

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Table 3

Sociodemographic correlates of multiply imputed DSM-IV/CIDI attention-deficit hyperactivity disorder in all WMH countries combined (n = 26,744)

	Childhood ADHD				Adult ADHD among childhood cases of …				Adult ADHD in the total sample		(n)[a]
	Threshold		Subthreshold		Threshold		Subthreshold		%	(SE)	
	%	(SE)	%	(SE)	%	(SE)	%[b]	(SE)			
Gender											
Male	2.7	(0.2)	4.3	(0.2)	57.5	(4.9)	42.0	(4.4)	3.4	(0.3)	(11,491)
Female	1.7	(0.1)	3.2	(0.2)	56.2	(5.2)	39.8	(5.2)	2.2	(0.2)	(15,253)
$\chi^{2,b}$	24.0*		18.4*		0.0		0.3		26.8*		
Age											
18–24	2.4	(0.2)	4.3	(0.3)	60.9	(6)	43.5	(5)	3.3	(0.4)	(6632)
25–34	1.9	(0.2)	3.7	(0.2)	57.2	(6)	43.8	(5.3)	2.7	(0.3)	(10,112)
35–44	2.3	(0.2)	3.3	(0.3)	53.2	(5.6)	34.7	(5.4)	2.4	(0.3)	(10,000)
$\chi^{2,b}$	1.3		12.3*		2.8		1.4		12.4*		
Education											
No education	0.8	(0.5)	1.9	(0.9)	26.9	(23.4)	61.8	(20.3)	1.4	(0.8)	(570)
Some primary	2.3	(0.4)	4.1	(0.6)	75.2	(8.2)	47.1	(8.2)	3.6	(0.6)	(1690)
Finished primary	1.4	(0.2)	4.4	(0.8)	71.2	(8.4)	37.8	(11.8)	2.7	(0.7)	(2137)
Some secondary	2.5	(0.3)	3.7	(0.4)	54.5	(8.3)	35.5	(5.6)	2.6	(0.4)	(5027)
Finished secondary	2.3	(0.2)	3.9	(0.3)	58.0	(5.9)	44.0	(5.2)	3.1	(0.3)	(8244)
Some college	2.8	(0.3)	4.3	(0.4)	54.9	(5.2)	41.6	(6.3)	3.4	(0.4)	(4662)
Finished college	1.6	(0.2)	2.6	(0.3)	50.1	(7.5)	38.1	(6.7)	1.8	(0.3)	(4414)
$\chi^{2,b}$	21.1*		16.1*		1.6		0.4		16.1*		
Employment status											
Employed	2.3	(0.1)	4.1	(0.2)	52.7	(4.7)	41.4	(4.5)	2.9	(0.3)	(17,660)
Student	1.7	(0.3)	2.5	(0.4)	74.1	(9.2)	41.2	(8.9)	2.3	(0.4)	(1669)
Homemaker	1.1	(0.2)	2.3	(0.3)	61.7	(9.3)	44.4	(7.9)	1.7	(0.3)	(4020)
Retired	3.2	(2.2)	1.2	(0.8)	52.0	(16.2)	39.8	(29.4)	2.2	(1.5)	(78)
Unemployed	2.9	(0.4)	4.3	(0.5)	68.1	(7.5)	37.4	(8)	3.6	(0.6)	(3317)
$\chi^{2,b}$	0.5		0.2		11.3*		0.1		1.4		

	Childhood ADHD				Adult ADHD among childhood cases of …				Adult ADHD in the total sample		(*n*)[a]
	Threshold		Subthreshold		Threshold		Subthreshold		%	(SE)	
	%	(SE)	%	(SE)	%	(SE)	%[b]	(SE)			
Marital status											
Married/cohabitating	2.0	(0.1)	3.5	(0.2)	53.6	(5.1)	38.8	(4.9)	2.4	(0.3)	(16,000)
Previously married	4.2	(0.5)	4.2	(0.8)	54.8	(7.4)	43.8	(11.8)	4.1	(0.8)	(1862)
Never married	2.3	(0.2)	4.1	(0.3)	61.8	(5.8)	43.5	(4.5)	3.2	(0.3)	(8882)
$\chi^{2,b}$	2.8		3.2		3.2		1.2		8.4*		
Income[c]											
Low	2.1	(0.2)	3.6	(0.3)	65.3	(5.1)	43.1	(5.2)	3.0	(0.3)	(7528)
Low-average	2.6	(0.3)	4.0	(0.3)	51.2	(6.6)	42.0	(5.8)	3.0	(0.4)	(6263)
High-average	2.4	(0.2)	3.8	(0.4)	58.0	(5.8)	37.3	(5.6)	2.8	(0.4)	(6719)
High	1.7	(0.2)	3.5	(0.3)	51.7	(7.1)	41.9	(6)	2.4	(0.3)	(6234)
$\chi^{2,b}$	1.1		0.9		0.0		0.5		1.6		

Based on multivariate logistic regression equations in which all predictors were included simultaneously. All models include dummy variable controls for surveys

*Significant at the .05 level, two-sided design-based multiply imputed test

[a]These are denominator *n*'s; that is, numbers of respondents in the total sample with the sociodemographic characteristic defined by the row heading

[b]Each Chi-square test has one degree of freedom. Tests for age, education, and income are based on continuous versions of those predictors. The test for employment status compares employed to all others. The test for marital status compares married/cohabiting to all others

[c]Income is defined as the ratio of pre-tax family income to number of household members. Households with ratios half the median within-survey value or lower were categorized as "low" income; those with ratios between half the median and the median were categorized as "low average"; those with ratios greater than the median up to three times the median as "high average"; and those greater than three times the median as "high"

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Table 4

Bivariate 12-month co-occurrence and lifetime age-of-onset temporal priority of multiply imputed DSM-IV/CIDI adult attention-deficit hyperactivity disorder with other DSM IV/CIDI disorders (n = 26,744)

	Conditional prevalence estimates				Age-of-onset temporal priority						OR	(95% CI)	(n)[c]
	ADHD/Co[a]		Co/ADHD[b]		ADHD first		Other disorder first		Both in the same year				
	%	(SE)	%	(SE)	%	(SE)	%	(SE)	%	(SE)			
I. Mood disorders													
Major depressive disorder	8.1	(0.8)	15.0	(1.5)	86.0	(2.7)	8.9	(2.3)	5.1	(2.1)	2.5*	(2.0–3.2)	(199)
Bipolar	15.2	(1.7)	9.4	(1.3)	94.0	(2.7)	3.1	(2.1)	2.8	(1.9)	5.4*	(4.0–7.2)	(92)
Any mood	9.3	(0.8)	21.9	(1.9)	86.4	(2.2)	8.3	(1.8)	5.3	(1.6)	3.2*	(2.6–4.1)	(287)
II. Anxiety disorders													
General anxiety disorder	8.3	(1.5)	3.8	(0.7)	83.9	(7.4)	9.3	(6.2)	6.8	(4.5)	2.6*	(1.7–3.9)	(47)
Panic disorder	14.4	(2.3)	5.7	(1.0)	90.2	(3.9)	3.9	(2.0)	5.9	(3.7)	4.5*	(3.0–6.6)	(70)
Specific phobia	8.9	(0.9)	20.9	(1.9)	29.1	(4.4)	53.1	(4.6)	17.8	(3.0)	3.4*	(2.6–4.3)	(250)
Social phobia	12.0	(1.4)	12.6	(1.4)	70.5	(4.7)	16.5	(3.8)	13.0	(2.7)	3.9*	(2.9–5.1)	(152)
Any anxiety	8.8	(0.7)	34.2	(2.4)	48.0	(3.4)	37.9	(3.5)	14.2	(2.1)	3.7*	(3.0–4.6)	(400)
III. Substance use disorders													
Alcohol abuse without dependence	9.4	(1.7)	5.1	(1.0)	98.0	(2.0)	2.1	(2.0)	0.0	(0.0)	3.0*	(1.9–4.6)	(49)
Drug abuse without dependence	16.1	(5.1)	2.7	(0.9)	94.8	(5.3)	0.0	(0.0)	5.2	(5.3)	4.8*	(2.3–10.1)	(16)
Any substance use	11.5	(1.5)	11.4	(1.6)	99.1	(0.9)	0.9	(0.9)	0.0	(0.0)	3.8*	(2.8–5.2)	(100)
IV. Behavior disorders													
Intermittent explosive disorder	10.9	(1.4)	12.8	(1.6)	78.7	(5.1)	12.6	(4.5)	8.7	(3.2)	3.8*	(2.7–5.2)	(101)
ODD[d] or adult antisocial behavior disorder	35.5	(4.5)	8.3	(1.4)	49.8	(7.6)	25.7	(6.9)	24.5	(7.9)	15.0*	(9.7–23.2)	(83)
Any behavior	15.6	(1.6)	15.2	(1.7)	64.5	(5.3)	19.0	(4.1)	16.5	(4.5)	6.2*	(4.6–8.4)	(169)
V. Total													
Exactly one[e]	5.5	(0.6)	23.0	(1.9)	73.8	(3.8)	18.1	(3.3)	8.1	(2.3)	3.0*	(2.3–3.9)	(242)
Exactly two[e]	11.2	(1.3)	14.3	(1.7)	90.6	(3.1)	5.6	(2.6)	3.8	(1.7)	6.2*	(4.4–8.8)	(163)
Three or more[e]	17.7	(1.7)	14.4	(1.6)	90.2	(2.6)	3.2	(1.2)	6.6	(2.1)	9.6*	(6.9–13.3)	(180)

	Conditional prevalence estimates				Age-of-onset temporal priority						OR	(95% CI)	(*n*)[c]
	ADHD/Co[a]		Co/ADHD[b]		ADHD first		Other disorder first		Both in the same year				
	%	(SE)	%	(SE)	%	(SE)	%	(SE)	%	(SE)			
Any	8.3	(0.6)	51.7	(3.1)	55.6	(2.8)	31.2	(2.8)	13.2	(2.0)	4.4*	(3.4–5.7)	(585)

All models assessed with part II weight (except Iraq and Romania) and control for countries. ADHD is the outcome variable in the models. Countries without the row disorder are dropped from the % calculations and the models. ESEMeD countries (Belgium, Germany, Italy, Netherlands, Spain, France) do not have dysthymia, bipolar, drug use, and intermittent explosive disorder. PRC—Shenzhen does not have post-traumatic stress disorder, any of the substance use disorders, oppositional defiant disorder or adult antisocial behavior disorder. Portugal does not have drug use disorders. Iraq does not have oppositional defiant disorder or adult antisocial behavior disorder. Mexico, Spain—Murcia, and Colombia—Medellin all do not have intermittent explosive disorder

*Significant at the .05 level, two-sided test

[a]Conditional prevalence estimates of adult ADHD in the subsamples of respondents with the comorbid disorders

[b]Conditional prevalence estimates of the comorbid disorders in the subsample of respondents with adult ADHD

[c]Denominator n is the number of people with both ADHD and the row disorder

[d]Oppositional defiant disorder

[e]Onset of “Exactly two” disorders takes the age-of-onset of the second earliest disorder the respondent was assessed with. Onset of “Three or more” disorders takes the third earliest disorder the respondent was assessed with

Table 5

Associations of childhood ADHD subtypes with comorbid lifetime DSM-IV/CIDI disorders, in all countries combined (n = 26,744)

	Active versus remitted ADHD		Remitted childhood AD-only		Remitted childhood HD	
	OR	**(95% CI)**	**OR**	**(95% CI)**	**OR**	**(95% CI)**
I. Mood disorders						
Major depressive disorder	1.2	(1.0–1.6)	2.0*	(1.6–2.5)	1.7*	(1.3–2.2)
Bipolar	2.0*	(1.3–2.9)	1.7*	(1.0–2.8)	2.3*	(1.5–3.6)
II. Anxiety disorders						
Panic or agoraphobia	1.5	(1.0–2.1)	1.9*	(1.2–2.9)	1.6*	(1.1–2.6)
General anxiety disorder	1.6	(1.0–2.7)	1.4	(0.8–2.5)	1.9*	(1.1–3.4)
Specific phobia	1.9*	(1.1–3.3)	1.3	(0.7–2.2)	1.2	(0.7–2.2)
Social phobia	1.7*	(1.0–2.7)	1.6	(1.0–2.7)	1.3	(0.8–2.3)
III. Substance use disorders						
Alcohol abuse with or without dependence	1.3	(0.9–1.7)	2.0*	(1.5–2.8)	2.2*	(1.6–2.9)
Drug abuse with or without dependence	1.4*	(1.1–2.0)	2.0*	(1.4–3.0)	2.7*	(1.8–4.0)
IV. Behavior disorders						
Intermittent explosive disorder	2.7*	(1.7–4.4)	1.1	(0.7–1.8)	1.2	(0.7–2.1)
Oppositional defiant disorder	4.6*	(1.7–12.1)	0.8	(0.3–2.3)	1.1	(0.4–2.8)

All models are person-year models assessed with part II weight (except Iraq and Romania), controlling for time-invariant dummies for country, sex, dummy for threshold childhood ADHD, time-varying continuous age, age-squared, and dummy active (time-varying dummy for whether the int is less than or equal to the age of recency of ADHD)

*Significant at the .05 level, two-sided test

Table 6

Disability in 30-day functioning associated with DSM-IV/CIDI adult attention-deficit hyperactivity disorder (n = 26,744)

	Prevalence of disability		With controls for socio-demographics[b]		With controls for socio-demographics and comorbid 12-month DSM-IV/CIDI disorders[c]	
	%[a]	(SE)	OR	(95% CI)	OR	(95% CI)
Cognition	21.8	(2.0)	3.8*	(2.9–4.8)	2.1*	(1.6–2.8)
Social interaction	10.8	(1.4)	3.3*	(2.4–4.4)	1.5*	(1.1–2.1)
Self-care	4.8	(0.9)	2.1*	(1.4–3.3)	1.2	(0.8–1.8)
Mobility	15.5	(1.6)	2.5*	(1.9–3.3)	1.6*	(1.2–2.0)
Days out of role	29.3	(2.2)	2.6*	(2.1–3.3)	1.6*	(1.3–2.1)

*Significant at the .05 level, two-sided test

[a]% with disability among those with ADHD

[b]Based on logistic regression equations controlling for country, sex, age, education, employment, marital status, and income. Twelve-month disability is the outcome variable in the models. The ORs presented are for ADHD as the predictor

[c]Based on logistic regression equations controlling for country, sex, age, education, employment, marital status, income, any 12-month mood disorder, any 12-month anxiety disorder, any 12-month substance use disorder. Thirty-day disability is the outcome variable in the models. The ORs presented are for ADHD as the predictor

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Table 7

Twelve-month treatment among respondents with multiply imputed DSM-IV/CIDI adult attention-deficit hyperactivity disorder (n = 26,744)

	General medical		Any mental health		Human services		CAM[b]		Any professional		Any treatment for ADHD	
	%[a]	(SE)	%[a]	(SE)	%[a]	(SE)	%[a]	(SE)	%[a]	(SE)	%[a]	(SE)
I. High income countries												
Belgium	10.5	(10.5)	13.8	(7.8)	0.0	(0.0)	0.0	(0.0)	21.5	(11.1)	0.0	(0.0)
France	7.4	(2.7)	5.6	(3.3)	0.0	(0.0)	0.0	(0.0)	9.6	(3.6)	0.0	(0.0)
Germany	0.0	(0.0)	6.9	(5.8)	2.7	(2.8)	0.0	(0.0)	9.7	(6.0)	0.0	(0.0)
Italy	10.6	(4.2)	4.4	(2.8)	0.0	(0.0)	1.3	(1.3)	11.9	(4.5)	0.0	(0.0)
Netherlands	18.6	(9.1)	18.8	(10.5)	2.2	(2.2)	12.3	(8.6)	23.8	(10.8)	1.9	(1.7)
Northern Ireland	18.9	(6.7)	13.9	(6.2)	0.6	(0.6)	2.6	(2.6)	25.5	(9.1)	0.6	(0.6)
Poland	7.2	(5.9)	3.5	(2.6)	4.2	(3.1)	0.0	(0.0)	12.9	(6.9)	5.8	(5.7)
Portugal	20.4	(8.0)	4.9	(3.3)	1.8	(1.8)	0.0	(0.0)	22.4	(8.1)	0.0	(0.0)
Spain	10.2	(5.6)	13.9	(6.9)	0.0	(0.0)	0.0	(0.0)	19.9	(8.9)	3.2	(3.4)
Spain—Murcia	10.4	(5.8)	4.2	(6.0)	0.0	(0.0)	0.0	(0.0)	14.6	(5.2)	0.0	(0.0)
USA	27.9	(4.3)	28.6	(3.8)	12.5	(2.5)	9.3	(2.3)	49.7	(4.1)	13.2	(2.9)
Total	17.9	(2.2)	15.9	(2.0)	4.9	(1.0)	4.4	(1.1)	28.8	(2.6)	5.1	(1.1)
II. Upper-middle income countries												
Brazil—São Paulo	7.2	(2.4)	12.3	(3.3)	1.1	(1.0)	4.8	(2.1)	20.4	(4.2)	1.9	(1.1)
Colombia—Medellin	1.3	(1.3)	7.7	(3.7)	0.0	(0.0)	0.0	(0.0)	9.0	(4.4)	0.0	(0.0)
Lebanon	0.3	(1.5)	0.8	(0.9)	0.0	(0.0)	0.0	(0.0)	1.1	(1.7)	0.0	(0.0)
Mexico	2.9	(1.9)	8.2	(4.9)	0.0	(0.0)	2.1	(1.4)	12.4	(5.1)	1.9	(1.9)
Romania	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)
Total	4.9	(1.5)	9.8	(2.2)	0.7	(0.6)	3.1	(1.3)	15.5	(2.8)	1.4	(0.7)
III. Low/lower-middle income countries												
Columbia	0.6	(0.4)	6.4	(3.3)	0.4	(0.4)	0.8	(0.8)	7.2	(3.4)	0.0	(0.0)
Iraq	0.0	(0.0)	0.0	(0.0)	0.7	(1.2)	0.0	(0.0)	0.7	(1.2)	0.0	(0.0)
Peru	0.0	(0.0)	12.9	(4.9)	0.0	(0.0)	3.6	(3.5)	15.7	(5.7)	0.0	(0.0)
PRC[c]—Shenzhen	1.0	(0.8)	2.3	(2.3)	0.0	(0.0)	2.4	(1.3)	5.4	(2.8)	0.0	(0.0)
Total	0.6	(0.3)	5.0	(1.6)	0.3	(0.2)	1.6	(0.8)	6.8	(1.8)	0.0	(0.0)
IV. Total	11.8	(1.4)	12.6	(1.4)	3.1	(0.7)	3.7	(0.7)	21.8	(1.9)	3.3	(0.7)

	General medical		Any mental health		Human services		CAM[b]		Any professional		Any treatment for ADHD	
	%[a]	(SE)	%[a]	(SE)	%[a]	(SE)	%[a]	(SE)	%[a]	(SE)	%[a]	(SE)
χ^2	51.7*		13.7*		16.5*		3.6		35.8*		3.6	

*Significant at the .05 level, two-sided test

[a]% with 12-month treatment among those with ADHD

[b]Complimentary and alternative medicine

[c]People’s Republic of China